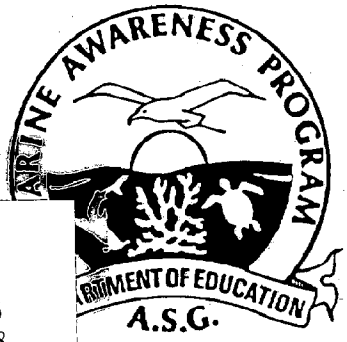
American Samoa - Coastal Management Program

PROCEEDINGS
of the
FIRST ANNUAL
AMERIKA SAMOA
MARINE SYMPOSIUM

March 10, 1988



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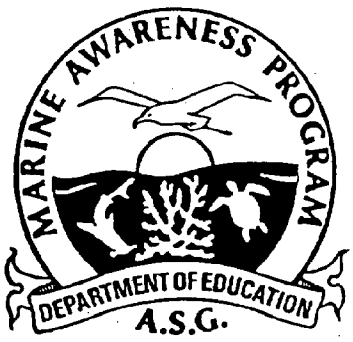

American Samoa Coastal Management Program
Economic and Development Planning Office
American Samoa Government
Pago Pago, American Samoa 96799
684-633-5155

AMERICAN SAMOA COASTAL MANAGEMENT PROGRAM

In reply refer to:

FOREWORD

The First Amerika Samoa Marine Symposium, coordinated by the Division of Curriculum & Instruction, Department of Education, was designed primarily to provide the high school students the opportunity to learn how to conduct a scientific research project, write a scientific paper, present their reports orally to an audience of scientists, teachers and peers, and to promote interest in marine affairs.

All high schools students (Grades 9 - 12) were invited and encouraged to participate in the Symposium. Requirements for participation included a research project, a written paper (3-10 pages) using data from a research project, and an oral presentation of the paper in front of an audience. The written papers were due on January 5, 1988 and the oral presentations were made on March 10, 1988.

The Symposium was initiated by the Division of Curriculum & Instruction (DCI), Department of Education (DOE), and financial support was provided by the American Samoa Coastal Management Program (ASCMP). A coordinated effort by several individuals to help put this Symposium together was not an easy task. They all are to be commended for their hard and unselfish work.

Special "*Fa'a malo*" (thanks) go to Rick Davis, Science Coordinator for DOE, Matt Le'i, Marine Awareness Program Coordinator (DOE) and the whole staff of DCI; Robert Morrow from the ASCMP; all the teachers from the participating high schools; and to everybody that helped out with the organization of the Symposium. Last but not least, I would also like to recognize all those volunteers who dealth with the editing and judging of student papers. Your assistance made it possible for our students to have quality papers at the end.

The students were interested and excited to get involved with a research project. The top three projects were invited to participate in the Thirteenth Annual Student Symposium on Marine Affairs in Honolulu on April 30, 1988. Our students' participation in the Hawaii Symposium provided them outside exposure to other scientists, students, and teachers.

The First Symposium was a big success and the ASCMP is very proud to be part of this project. We are looking forward to continuing support of such effort in promoting public awareness in the field of marine science.

Henry Sesepasara
ASCMP, Program Manager

FIRST ANNUAL AMERIKA SAMOA MARINE SYMPOSIUM

CONTENTS

AMERIKA SAMOA MARINE SYMPOSIUM

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Marine Awareness Program,
Department of Education.

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Robert Strong
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ASCC
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**The Committee would also like to thank all those that participated as judges for the Symposium.

PLEASE POST

announcing the...
1st Amerika Samoa
MARINE SYMPOSIUM
for
all high school students

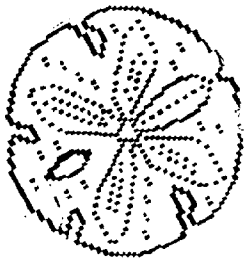
Learn how to conduct a research project and how to write a scientific paper. Be the best be a SCIENTIST. Write a 3-10 page paper following symposium guidelines. Paper due January 5, 1988 and deliver the paper orally at a public symposium on March 10, 1988.

You can use basic data you have already for a science fair project or start from scratch. It is your own research, writing and speaking which are important.

The two or three best written and presented papers will be selected to attend the Hawaii Student Symposium on Marine Affairs in April.

Funding for the symposium is provided by a grant from the America Samoa Coastal Management Program.

For more information and guideline copies contact:



Rick Davis or Matt Le'i 633-1246
Division of Curriculum & Instruction
Utulei

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Joseph Stanislaus - Samoana H.S.
Etene Levi/Lokeni Nu'usolia - Tafuna H.S.
Talofa Leala/ Saipale Fuimaono - Fagaitua H.S.
Doug Foster - Tafuna Technical H.S.
Suzanne Aina - Manu'a H.S.
Christina Keenan - Fa'asao H.S.
Mario Brunetta - Marist H.S.

RECOGNITION OF ACHIEVEMENT

In recognition of the fine efforts made by each of student who successfully carried out their research, wrote a paper and made an oral presentation based on that paper at the First Annual Amerika Samoa Marine Symposium the following Certificate of Merit was given. Congratulations to each recipient.

AMERIKA SAMOA MARINE SYMPOSIUM

STUDENT ADVISORS

Doug Foster.....Tafuna Techincal High School.

Joanie Cahill.....Fa'asao High School.

Larry Madrigal.....Leone High School.

Mario Brunetta..... Marist High School

Suzanne Aina.....Manu'a High School.

The Amerika Samoa Marine Symposium Committee would like to take this opportunity to thank each of the advisors for their generous efforts.

AMERIKA SAMOA MARINE SYMPOSIUM
FONO GUEST FALE. MARCH 10, 1988.

PROGRAM

5:00 p.m. .....REGISTRATION.
FONO GUEST FALE.

5:15 p.m. .....WELCOMING AND INTRODUCTION.
MATT T. LEI. MARINE AWARENESS PROGRAM, DEPT. OF EDUCATION.

.....KEYNOTE SPEAKER.
HON. LT. GOVERNOR, FALEOMAVAEGA ENI HUNKIN.

5:45 p.m. .....PRESENTATION OF PAPERS.

8:30 p.m. .....AWARDS AND CLOSING CEREMONY.

.....CLOSING REMARKS.
RICK DAVIS. SCIENCE COORDINATOR, DEPT. OF EDUCATION.

FIRST ANNUAL AMERIKA SAMOA MARINE SYMPOSIUM

STUDENT PRESENTERS

* PAPERS FROM MANU'A HIGH SCHOOL WERE NOT AVAILABLE FOR THIS PRINTING.

COLIFORM POLLUTION IN PAGO HARBOR
(A TWO YEAR STUDY)

by Tana Crookshank

ABSTRACT

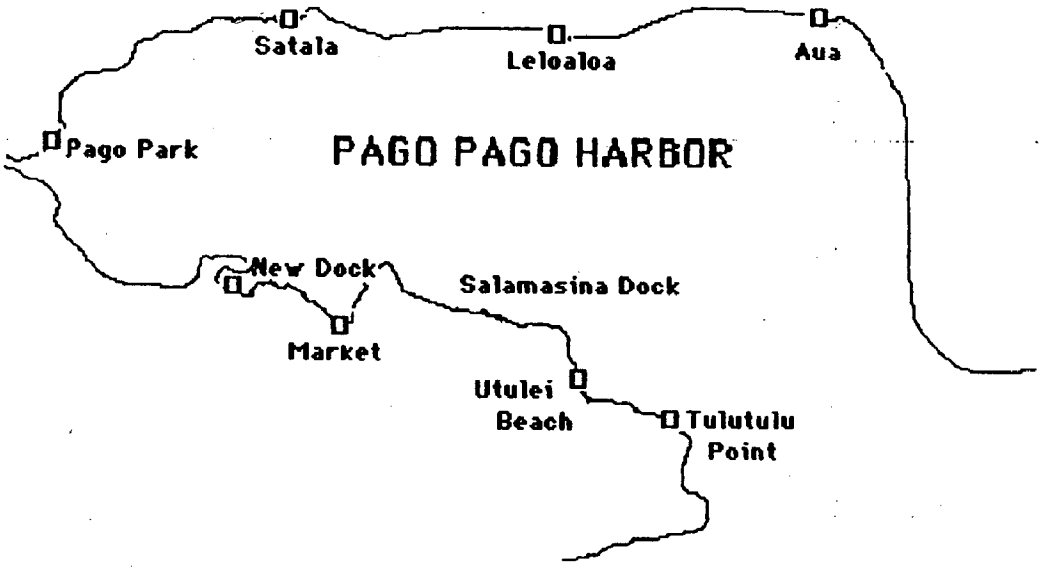
Testing for both total and fecal coliform bacteria at nine sites in Pago Harbor indicates that several sites exceed American Samoa safety standards. However, the tests for 1987 yield much lower counts than those of 1985.

PROBLEM STATEMENT

Fecal coliform is an indicator of recent human sewage contamination. Total coliform is a combination of various organisms and their contamination. Escheria coli is a well-known bacteria found in human and warm-blooded animal intestines. Large numbers are also found in human feces. For this reason , detection of Escheria coli in natural waters is used as an indicator of fecal coliform contamination and it is relatively high where there has been recent sewage pollution. Pago Harbor receives boat, factory, and domestic sewage, wastes from holding tanks, and animal wastes (i.e. piggeries). It was, therefore, expected that on testing water samples from the harbor, Escheria coli and other coliforms would be found, suggesting the presence of pathogenic micro-organisms.

In 1985, especially high counts of E. coli were expected at the Salamasina Dock and Satala because of heavy traffic, while low counts were expected at the other testing sites (Crookshank, 1985).

Because of the data obtained in 1985, high counts were expected at Tulutulu Point, Salamasina Dock, Market, Satala, and Aua in 1987 because of


Satala
Leloaloa
Aua
Pago Park
PAGO PAGO HARBOR
New Dock
Salamasina Dock
Market
Utulei
Beach
Tulutulu
Point

(Figure 1)

their locations in areas of high traffic. The remaining sites were expected to yield lower counts similar to those of 1985 .

LITERATURE REVIEW

Water which looks clear can be thoroughly contaminated with pathogenic micro-organisms (Brock, 1974,1979). In the United States recreational waters, the coliform count is usually not allowed to exceed the United States standards of 1000 bacteria per 100 ml. of water. Public health officials close beaches on this basis because of risk to the general public of receiving enteric viruses or an intestinal infection.

The rate for determination of coliform contamination in American Samoa is 200 bacteria per 100 ml. of water.

Determination of fecal contamination within shellfishing waters is of prime importance because shellfish provide a reservoir for infectious hepatitis. Therefore, in the United States, shellfishing is prohibited if the fecal count exceeds 2300 bacteria per 100 ml. of water (Mitchell, 1974).

Pago Harbor has always been used by the people of American Samoa as a recreational site and a fishing area. If any sites yield higher counts than the United States' or American Samoa's standards, a potential health hazard is present.

METHOD

At each of the nine sites (Fig. 1), a sample of water was taken from a measured depth of 1 foot. To complete my study of the total and fecal coliform count at each of these sites, I chose the membrane filterizatio process.

Fifteen (15) ml. of each sample was filtered through a separate bacteriological membrane to test for fecal coliform. Each membrane was placed on methylene blue lactose in a petri dish. Each petri dish was then put in a water bath incubator set at 44 Celsius for 24 hours. Following incubation, the colonies of fecal coliform were counted, compared, and recorded.

Another 15 ml. of each sample was filtered through a bacteriological membrane to test for total coliform. Each membrane was placed on lactose-peptone agar eosin in a petri dish. Each petri dish was then put in an incubator set at 35 Celsius for 24 hours. Following incubation, the colonies of total coliform were counted, compared and recorded.

To determine the number of coliform bacteria present, the number of colonies was counted. If the colonies almost completely covered the bacteriological membrane and were unable to be counted because of their fusion, then the figure was considered too numerous to count (TNTC). If a site's count was TNTC, then not only did it exceed American Samoa's standards but also the United States' standards .

This process for both coliform counts was completed on each testing day once a week for four weeks in 1985 and again in 1987.

RESULTS

Of the samples taken at high tide on February 14, 1985 (Table 1), the sites showing total coliform too numerous to count were Tulutulu Point, the Salamasina Dock, and Aua. Of these, only Tulutulu Point yielded a fecal coliform count high enough to exceed the standards of American Samoa and the United States. Utulei Beach, the Market, the New Dock, Pago Park,

and Leloaloa were found to have total and fecal coliform counts but not excessive amounts (Crookshank, 1985).

At low tide on February 21,1985 (Table 2), TNTC total coliform counts were found at the Market and Pago Park. The other sites yielded low counts. The fecal coliform count was negative except for Satala and Leloaloa which showed very few bacteria (Crookshank, 1985).

At high tide on February 28, 1985 (Table 3), the results for the total coliform counts proved to be much the same as during the high tide of February 14th. For fecal coliform counts, however, Tulutulu Point and Aua exceeded the standards of both American Samoa and the United States for fecal coliform contamination (Crookshank, 1985).

At low tide on March 7, 1985 (Table 4), the only site with a total coliform count TNTC was Aua. The other sites were relatively low in their count. For the fecal coliform count, all but the Salamasina Dock, Pago Park , and Leloaloa showed signs of having fecal coliform present (Crookshank, 1985).

At low tide on December 2, 1987 (Table 5), no sites showed either fecal or total coliform in numbers too numerous to count. In fact, every site was well below American Samoa's and the United States' safety standards.

Of the samples taken at high tide on December 9, 1987 (Table 6), no sites exceeded American Samoa's or the United States' safety standards, and counts were relatively low for both total and fecal coliform. Tulutulu Point and Utulei Beach yielded no counts for either total or fecal coliform.

At low tide on December 16, 1987 (Table 7), again no sites exceeded American Samoa's or the United States' safety standards for both total and fecal coliform.

At high tide on December 23, 1987 (Table 8), every site excluding Tulutulu Point, Utulei Beach, and the New Dock exceeded both American Samoa's and the United States' safety standards for total coliform. For the fecal coliform count, every site excluding Tulutulu Point, Utulei Beach, the New Dock , and Pago Park yielded TNTC counts.

TABLE 1 . February 14, 1985, HIGH TIDE

SITE	Total Coliform Count	Fecal Coliform Count
Tulutulu Point	TNTC*	TNTC*
Utulei Beach	21	4
Salamasina Dock	TNTC*	31
Market	32	5
New Dock	33	26
Pago Park	12	0
Satala	TNTC*	58
Leloaloa	43	9
Aua	TNTC*	68

TABLE 2. FEBRUARY 21, 1985, LOW TIDE

SITE	Total Coliform Count	Fecal Coliform Count
Tulutulu Point	6	0
Utulei Beach	2	0
Salamasina Dock	40	0
Market	TNTC*	0
New Dock	15	0
Pago Park	TNTC*	0
Satala	25	1
Leloaloa	16	2
Aua	TNTC*	0

TABLE 3. FEBRUARY 28, 1985, HIGH TIDE

SITE	Total Coliform Count	Fecal Coliform Count
Tulutulu Point	TNTC*	TNTC*
Utulei Beach	7	40
Salamasina Dock	TNTC*	73
Market	42	11
New Dock	30	27
Pago Park	11	8
Satala	TNTC*	65
Leloaloa	52	10
Aua	TNTC*	TNTC*

TABLE 4. MARCH 7, 1985, LOW TIDE

SITE	Total Coliform Count	Fecal Coliform Count
Tulutulu Point	23	15
Utulei Beach	6	2
Salamasina Dock	30	0
Market	52	1
New Dock	25	7
Pago Park	2	0
Satala	26	10
Leloaloa	14	0
Aua	TNTC*	8

*TNTC- Too numerous to count

TABLE 5. DECEMBER 2, 1987, LOW TIDE

SITE	Total Coliform Count	Fecal Coliform Count
Tulutulu Point	0	0
Utulei Beach	0	0
Salamasina Dock	1	2
Market	20	19
New Dock	1	1
Pago Park	3	2
Leloaloa	11	0
Aua	23	4

TABLE 6. DECEMBER 9, 1987, HIGH TIDE

SITE	Total Coliform Count	Fecal Coliform Count
Tulutulu Point	0	0
Utulei Beach	0	0
Salamasina Dock	9	4
Market	1	1
New Dock	1	0
Pago Park	>200	>100
Satala	21	5
Leloaloa	17	4
Aua	1	0

TABLE 7. DECEMBER 16, 1987. LOW TIDE

SITE	Total Coliform Count	Fecal Coliform Count
Tulutulu Point	>200	>100
Utulei Beach	>200	>100
Salamasina Dock	11	1
Market	>100	87
New Dock	>200	>100
Pago Park	>200	>100
Satala	>200	>100
Leloaloa	>200	>100
Aua	>200	>100

TABLE 8. DECEMBER 23, 1987. HIGH TIDE

SITE	Total Coliform Count	Fecal Coliform Count
Tulutulu Point	>200	48
Utulei Beach	27	12
Salamasina Dock	TNTC*	TNTC*
Market	TNTC*	TNTC*
New Dock	>200	44
Pago Park	TNTC*	>100
Satala	TNTC*	TNTC*
Leloaloa	TNTC*	TNTC*
Aua	TNTC*	TNTC*

*TNTC-Too numerous to count

DISCUSSION

In 1985, the high counts at the Salamasina Dock and Satala and the low counts at Utulei Beach supported my hypothesis. The low counts found at the Market, Pago Park, Aua, and Tulutulu Point, however, did not support my hypothesis. Tulutulu Point was found later to be occasionally polluted with sewage released from a nearby sewage plant. The sewage is usually chlorinated , but sometimes the plant experiences a shortage of chlorine and cannot treat the sewage properly. Reasons for the other sites' pollution are still undetermined but probably depend greatly on streams running directly into the harbor, piggeries located by these streams, various human activities, and ocean currents, which would also seem to be the cause of varied coliform counts at each site after the results of each test.

In 1987, the low counts found at Tulutulu Point, the Salamasina Dock, the Market, Satala, and Aua did not support my hypothesis while the other sites yielded counts similar to those of 1985, i.e., coliform levels not exceeding accepted government standards.

The only noticable increase in total and fecal coliform counts that was observed on December 23, 1987 may have been due to the heavy rainfall that day. A number of streams run directly into Pago Harbor, and during a rain they erode the mountainside and carry much soil into the harbor. It is therefore believed that this soil caused the major increase in coliform counts.

Counts for total and fecal coliform seemed to be relatively lower in 1987 than in 1985. Reasons for this are undetermined but could be either the result of efforts made to control the sewage released into the harbor, the difference in the time of year that the testings occurred, the difference in rainfall during the different times of year, ~~of~~ the result of tidal current changes during different times of the year.

There may have been an experimental error during the collecting of the samples. When the samples were taken from a measured depth of one foot, the movemont of the waves may have interfered with the accuracy of the measurements.

CONCLUSION

From this study, it can be concluded that Pago Harbor is polluted with total and fecal coliform bacteria with respect to the safety levels set by the United States' and American Samoan governments.

The test results from 1985 and 1987 differ considerably, but the sources of coliform pollution are believed to be mainly boat, factory, and domestic sewage which is continually being channelled into the harbor.

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Crookshank, Tana. 1985. "Coliform Pollution in Pago Harbor". The Eleventh Annual Hawaiian Marine Symposium.

WATER POLLUTION

Sa'ovale Clara Mapu
Fa'asao High School
Grade 9

What causes water pollution?

There are many ways that water can be polluted. According to the American Samoan Environmental Protection Agency (ASEPA) - an agency taking care of our environment, there are many ways water can be polluted by people. This can be tested and proved in an EPA laboratory.

EPA lab technicians do this as a daily routine. Taking samples from wells, springs, streams or other sources people use for their drinking water. If they find the water to be contaminated they send a message to the local radio station, TV, and newspapers to alert the people to boil their water for drinking or filter the water before using for food. Even though the water may be clean to our eyes it could still be contaminated, then it is not suitable to drink. The kind of germs found in water cannot be seen unless we use a microscope.

We need to have clean water for drinking if we drink dirty water we may get some of the waterborne diseases, such as diarrhea or typhoid fever.

Who keeps your drinking water safe?
Local water systems:

1. Site wells and intakes (pipes that suck water into drinking water systems).

2. Sample water and maintain test records.

3. Notify the public if problems arise.

Local Pollution Control Agencies:

1. Protect surface water.

2. Protect ground water from contamination by controlling contaiminating sources.

3. Monitor ground water and detect contaminants.

EPA Drinking Water Program

1. Retain primary enforcement responsibility in areas/villages that have not attained "Government" water systems - e.g. Aoa, Amouli, Tula, etc.

2. Sets primary and secondary drinking water standards.

3. Establishes monitoring and reporting requirements.

What happens to your water before it comes out of the faucet?

1. EPA and Public Works work to protect the quality of ground and surface water needed to keep the villages supplied with safe drinking water.

2. Water is moved from surface and ground water sources to storage areas.

The major source of water in American Samoa is ground water which does not require filtration. However, for water that does require filtration, these additional steps are followed.

A. Water is strained to remove debris.

B. A chemical such as alum is added to coagulate particles.

C. Water moves slowly through sedimentation basins while solid particles sink to the bottom.

D. Water then flows through beds of gravel and sand for final filtering.

3. Chlorine or other disinfectants are added as final treatment to kill bacteria.

4. Water is then tested for purity to ensure that it does not contain any quanity of pollutants in excess of EPA's maximum contaminant levels.

5. Treated water goes to reservoirs or holding tanks. In some cases, it goes directly into the water system.

6. Drinking water comes gushing out of the faucet in your kitchen or bathroom.

Each of us need clean water for our needs. Everything in life depends on water but we cannot use polluted water. We must have clean water.

Listed below are some of sources of pollution.

1. One way we can pollute the water by using ava niu kini. They are not only destroying the coral but they kill fish and pollute the water. By polluting the water we may end up getting sick from the fish we eat.

2. From the ASEPA office I found out that some of the laundromats, garages, emptied their wastes water into the ocean. This is one way to pollute the water. On rainy days whatever lies on ground surface will be washed down to the ocean.

3. To help we should not litter into streams, rivers or on the beaches. Try to burn trash.

4. Other sources include the canneries, ships and oil tanks. Our harbor is one of the world's most attractive natural harbors. Keeping the harbor clean will help assure that it will be as beautiful for future generations. With the goal of keeping the harbor clean the government has developed rules and regulations for controlling garbage and various types of water pollution. We must understand these regulations.

Water Pollution Regulations.

Local Rules.

1. Local laws prohibit the dumping of garbage of sewage into the waters of American Samoa. Fines for polluting the harbor can be issued be the harbor patrol upto $1,000 for each offense.

2. The Environmental Quality Commission of American Samoa regulates what companies and manufacturers can put into the water. Fines for pollution under their rules can result in fines of upto $500 a day, or even closing of the company.

Federal Regulations.

1. Federal regulations allow for citations for much higher value, up to $25,000 in some instances. The U.S. Coast Guard can impound fishing boats and not allow them to sail until a bond has been posted or the fine paid.

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Weigman, Sheila. American Samoa Environmental Protection Agency, Pago Pago, American Samoa.

Songs of the Humpback Whale.

Wynona Panama - Leone High School.

ABSTRACT

Three basic kinds of sounds are produced by humpback whales, they include high,low,and changing or modulated frequencies. These three sounds, alternated and varied, make up the song that consists of seven basic types of sounds. These seven sounds have one to several variations of each. By audio spectrograph analysis, the songs reveal differences among songs of humpbacks from different geographical regions.

Introduction

Humpback whales produce a variety of sounds with an extraordinary range of tonal qualities, some of which probably help the whale keep in contact with others and may aid in navigation. They produce sounds including the highest and lowest frequencies humans can hear (Kaufman & Forestell,1986). How humpbacks create these sounds is unknown since they do not have functional vocal cords. Some evidence suggests that the sounds are produced by various valves, muscles, and a series of blind sacs found branching off the respiratory tract (Winn & Winn, 1985). Most of the sounds produced by humpbacks form long, complex patterns which are often repeated for hours.

A humpback song is composed of a series of discrete notes or units (Kaufman, 1986). A unit is the shortest discrete sound noticeable to the human ear. A series of units constitutes a "phrase" (Kaufman, 1986). Phrases are

usually uniform in duration, and may contain repeated sounds. A consecutive group of phrases makes up a "theme" (Kaufman, 1986). A predictable series of themes forms a "song"(Kaufman, 1986). A song generally lasts between 6 and 18 minutes depending on the number of phrases it includes (Kaufman,1986). A sequence of songs in which there are no pauses greater than one minute, is a "song session" (Kaufman,1986). (See figure A)

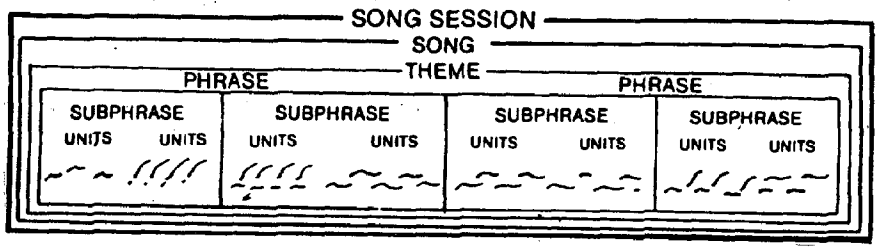
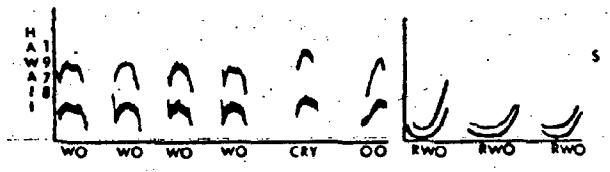
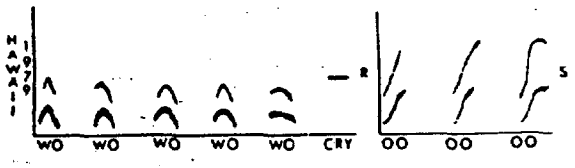


Figure A shows the individual units which when grouped together make up a song session (Kaufman, 1986).

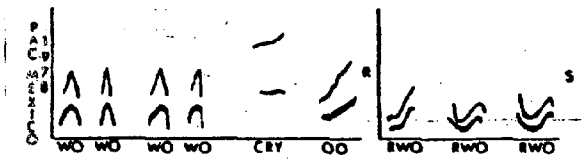
From season to season, the whale's song is in a constant state of evolution. As the song progresses, new themes may be introduced or old ones may be changed. For example, audio spectrographs recorded in 1978 & 1979 of humpback whale songs from Hawaii and the Pacific Mexico reveal these changes (Winn & Winn, 1985). (See figures below).



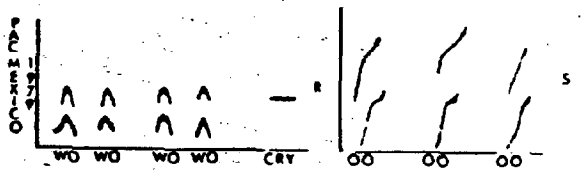
Hawaiin Humpback Whale, 1978.



Hawaiin Humpback Whale, 1979.



Pacific Mexican Whale, 1978.



Pacific Mexican Whale, 1979.

Each singer changes it's song to keep in tune with other singers. Also, the song heard in one season is quite different from the song heard in the next season. The song heard at the end of the season is quite different from the song heard at the beginning of the season as a result of the constant changes. Presently, data indicates little or no singing takes place during the summer and further change to the song does not appear to occur (Winn & Winn, 1985).

For the past 13 years,humpback whale songs have been recorded from the West Indies, Tonga, Bermuda, the Pacific Coast of Mexico, Hawaii, and the Cape Verde Islands by scientists (Winn & Winn, 1985). Humpbacks begin to sing just before or during migration to the breeding grounds in the tropics, and they continue to sing throughout the breeding season. Recent recordings made in the North Atlantic and in Alaska by scientists suggest that they begin to sing the full song just before migrating to the tropics, and that only portions of the song are sung throughout the summer months on the feeding grounds (Darling, 1979).

Three basic kinds of sounds are produced by the humpback: high, low, and changing or modulated frequencies (Winn & Winn, 1985). These three sounds, alternated and varied, make up the song. Often the sounds can be grouped into 6 themes, but in some years only four or five themes have been identified (Winn & Winn,1985). Listening to the call, especially when several whales are singing simultaneously, one gets the impression of a complex variety

of sounds. In fact, there are about seven basic types of sounds. They are moans cries, chirps, yups, oos, (and other changing frequency sounds), surface ratchets, and snores (Winn & Winn,1985). These 7 sounds have one to several variations of each. When humpback whale songs are analyzed, each sound is given a descriptive name to be able to distinguish the difference. Of the seven sounds only chirps and surface ratchets are missing from some calls (Winn & Winn,1985). At present, all the recordings to date always have the other sounds and are always present in some form though they are put together in different ways (Winn & Winn,1985).

The low-frequency sounds can be grouped into 4 types:moans, groans (a type of moan), snores, and surface ratchets (Winn & Winn,1985). The modulated or changing-frequency sounds are the largest group and include wavers, oos, ees, whos, wos, and foos; other sounds that change frequency more abruptly are the yups, and the similar mups and ups (Winn & Winn,1985). The high-frequency sounds are cries and chirps (Winn & Winn,1985). Moans or groans can be long, short, wavery, pulsed, or in two parts. There are several varieties of cries; chirps exhibit less variation. Variations of the snore include short snores, long snores, elephant snores, lion snores, and two-part snores (Winn & Winn,1985). The changing-frequency sounds have the greatest number of variations; they can be short, long pulsed, or in two parts (Winn & Winn, 1985). The surface ratchet, which

does not always occur, has only one or two variations (Winn & Winn, 1985). In the West Indies, the surface ratchet was found associated with surfacing, but this sound was absent in the Pacific Humpback's call (Winn & Winn,1985). Even when the surface ratchet is absent, each call has a particular sound or sounds associated with surfacing that is, surfacing invariably occurs at the same point in the song except when a disturbance causes the whale to surface earlier (Winn & Winn,1985).

Tape recordings of humpback whale songs were made off Hawaii on April 27,1985 and 10 weeks later off Stradbroke Island on the eastern coast of Australia. The Australian whale was recorded during the northward migration. Sonographic analysis and comparison between the two sets of songs revealed major contrasting features especially in the overall song organization and in the form of constituent phrases (Kaufman & Jenkins,1985).

The phrase types in the Hawaiian song were relatively short in duration containing few sound units where as by contrast several Australian phrases were very long (26-33 seconds) and were repeated only one to three times (Kaufman & Jenkins,1985). All the Hawaiian phrases were repeated much more frequently in some cases up to seventy times, in a single theme (Kaufman & Jenkins,1985). The four Australian phrases which more closely resembled the Hawaiian ones in length were repeated much less frequently (range 3 to 11 times) (Kaufman & Jenkins,1985). A notable characteristic of

the long Australian phrases was that the final one in a given theme was shortened by omitting some of the end sound units.

Three of the six Australian themes were "static", one showed marked "shifting" from phrase to phrase and two were "unstructured" (Kaufman & Jenkins,1985). There were no marked transitional phrases. The Hawaiian songs had a "shifting" phrase in only one of its themes and strongly marked transitional sequences between themes (Kaufman,1985).

In the Australian sample a complete song session, from blow to blow, started with a ratchet type theme, followed by two songs each of 6 themes in strictly repeated sequence. There was variability in the number of phrase repetitions within themes. After two complete songs the session ended with a ratchet theme either before the blow. The Hawaiian song did not have a ratchet theme at the start or the end and the sequence of themes was largely random. The concept that major ocean areas have characteristic humpback songs is strongly supported by this comparison (Kaufman, 1985).The differences clearly extend beyond the detailed form of song phrases to the basic organzation of the song form. The evidence suggests that southern and northern humpback whale stocks do not mix across the equatorial zone.

Since the humpback song was discovered to occur in the tropics during the mating season, little attention was paid to the sounds being produced on the feeding grounds. Recently, Nancy Reichley recorded and analyzed a variety of

sounds produced by humpbacks in the Cape Cod area during the summer months. She found that humpbacks have quite a repertoire of sounds consisting of about 21 basic sound types with at least 84 variations (Reichley,1983). The sounds were similar in type to those recorded in the tropics and included moans, grunts, yups, cries, and chirps. Very few of the sounds were arranged in continuous patterned sequences similar to the song of that year in the West Indies, and most were either produced sporadically or continuously with no songlike pattern.

Humpbacks sing for hours until one of two things happen. Either they are joined by another lone, nonsinging adult, or they stop and rush off to join a larger "mating" group. Peter Tyack has watched songers pursue nonsingers. He has also seen them join a group, stop songing, and engage in behavior usually associated with courtship and mating. Otherrs have seen singing humpbacks exhibiting aggressive behavior toward other humpbacks. All these behaviors imply that singing whales are males vying for the attention of females. Tyack also noted that as the breeding season progressed, the singers sang for longer periods.

CONCLUSION

Although much has been learned about the humpback songs, many questions still remain. For example : Why does the song change each year, do females ever sing, and what kinds of information are in the songs?

The humpback whale has the capability of analyzing and interpreting the sounds it produces. Although the song probably contains considerable information, data suggest that it is information of a rather simple kind. Whatever the purpose of the humpback song, we know the whale constantly repeats the same message over and over. Not only are individual sounds repeated, but groups of sounds are repeated, as is the entire song.

Why does the song change each year? The reason for these changes is not understood but it may be that a new song each year is more stimulating to the females, or that one dominant male decides the song for the year.

What kind of information is in the song? Frequency may be an important element in the whale's message. The humpback could be using different frequencies to send different messages to different individuals, since all humpback songs include a combination of frequencies. If all singing whales are in fact males, it has been implied that the low frequencies could be a threat to other males, the high frequencies a motive to females to come closer, and the changing frequencies a means of calling attention to themselves.

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A Device that Measures Light Intensity in Seawater.

Siaosi Savelio - Tafuna Techincal High School.

ABSTRACT

A device was built that was able to indicate light intensities at different depths. Temperature did not seem to affect the readings from the device. The device was sensitive to sunny and cloudy conditions at the same depth. The device consists of an ohm meter and materials that cost less than $7.00.

PROBLEM STATEMENT

An attempt was made to build a device that was able to measure the intensity of light at different depths.

LITERATURE REVIEW

The light penetration at different depths can be measured by a Secchi disc. The diameter of the Secchi disc is 20 to 30 centimeter (about 1 foot). The Secchi disc depth (the depth at which the disc will disappear), is a standard measure of transparency (Weiss and Dorsey 1979). One disadvantage the Secchi disc has is that the visibility of the disc depends upon how well the observer sees.

Photoresistros are devices whose resistance changes with the intensity of light. When light strikes the photoresistor, it increases the number of electrons available to carry current. Light of high intensity decreases the resistance and light of low intensity increases the resistance of the photoresistors (Mims, 1983). Some advantages of a device that uses a photoresistor to measure light intensity are 1) it eliminates the observer eyesight problem, 2) it measures light intensity at depths shallower that the Secchi disc dept, it measures light intensity at the

Secchi disc depth, and it measures light intensities at depths deeper than the Secchi disc depth.

MATERIALS AND METHODS

I made a Secchi disc from a paelo bottom. I placed a cadium sulfide photoresistor purchased from Radio Shack (catalog number 276-1657) on the Secchi disc. The photoresistor was then soldered to a 15.57 meter length of 18 gauge speaker wire. The speaker wire was purchased from Transpac in American Samoa. Two banana plugs were at the opposite end of the speaker wire (see figure 1). The two banana plugs were attached to a Micronta 21 range multimeter (Radio Shack catalog number 22-210). To prevent a short circuit, all exposed conductors were sealed with Krazy Glue R . The Secchi disc and the photoresistor were lowered into the sea with the speaker wire (see figure 1) at the pier in Pago Pago. The resistance measurements were made according to the following procedure. The meter was used to measure the resistance of the photoresistor at sea level. I lowered the photoresistor one meter at a time and recorded the resistance reading for each depth. To help the Secchi disc sink, I added weights to the bottom of the disc. The final readings were recorded when the photoresistor rested at the bottom of the sea (9 meters deep).

An attempt was made to see if the photoresistor was sensitive to temperature. The photoresistor was placed in a water bath whose temperature was lowered by adding ice. The range of the temperature for which the readings were made did not seem to affect the resistance of the photoresistor.

RESULTS

The primary factor that affects the resistance of the photoresistor is the amount of light falling on it. As the intensity of light striking the photoresistor

increases, the resistance of the photoresistor decreases. Figure 3 demonstrates the ability of this device to measure light intensities at different depths. The resistance reading of the photoresistor at sea level was 70 ohms. At the Secchi disc depth (2½m), the resistance reading of the photoresistor was 175 ohms. At the sea floor, the resistance of the photoresistor was 900 ohms.

Sunny and cloudy conditions did not seem to affect the Secchi disc depth. The two condition readings were taken within 15 minutes. However, the photoresistor was able to detect the differences in light intensity under the sunny and cloudy conditions. The photoresistor reading under sunny conditions was 70 ohms. The photoresistor reading under cloudy conditions was 140 ohms.

The device used to test the effect of temperature on the resistance of the photoresistor broke. The resistance reading of the photoresistor remained constant over the temperature range of 30°C, 26°C, and 22°C (150 ohms).

DISCUSSION

The addition of the photoresistor to the Secchi disc allows a person to quantify light intensity at different depths, including the Secchi disc depth. Since I still have the Secchi disc, I can compare my Secchi disc data to the data recorded in the past. The device I built also detected differences in the intensities of light due to sunny and cloudy conditions.

I was unable to calibrate the readings of the photoresistor against the units that are usually used to measure light intensity. This does not suggest that the device has no use. However, a conversion factor or a conversion table must be found before my values can be compared to the standard units.

The curve in Figure 3 is not a straight line. This may mean that the clarity of the seawater is not the same from sea level to the bottom.

Some possible uses of my device are 1) it might help to locate the maximum depth where photosynthesis takes place and 2) it might indicate pollution.

PICTORIAL DIAGRAM

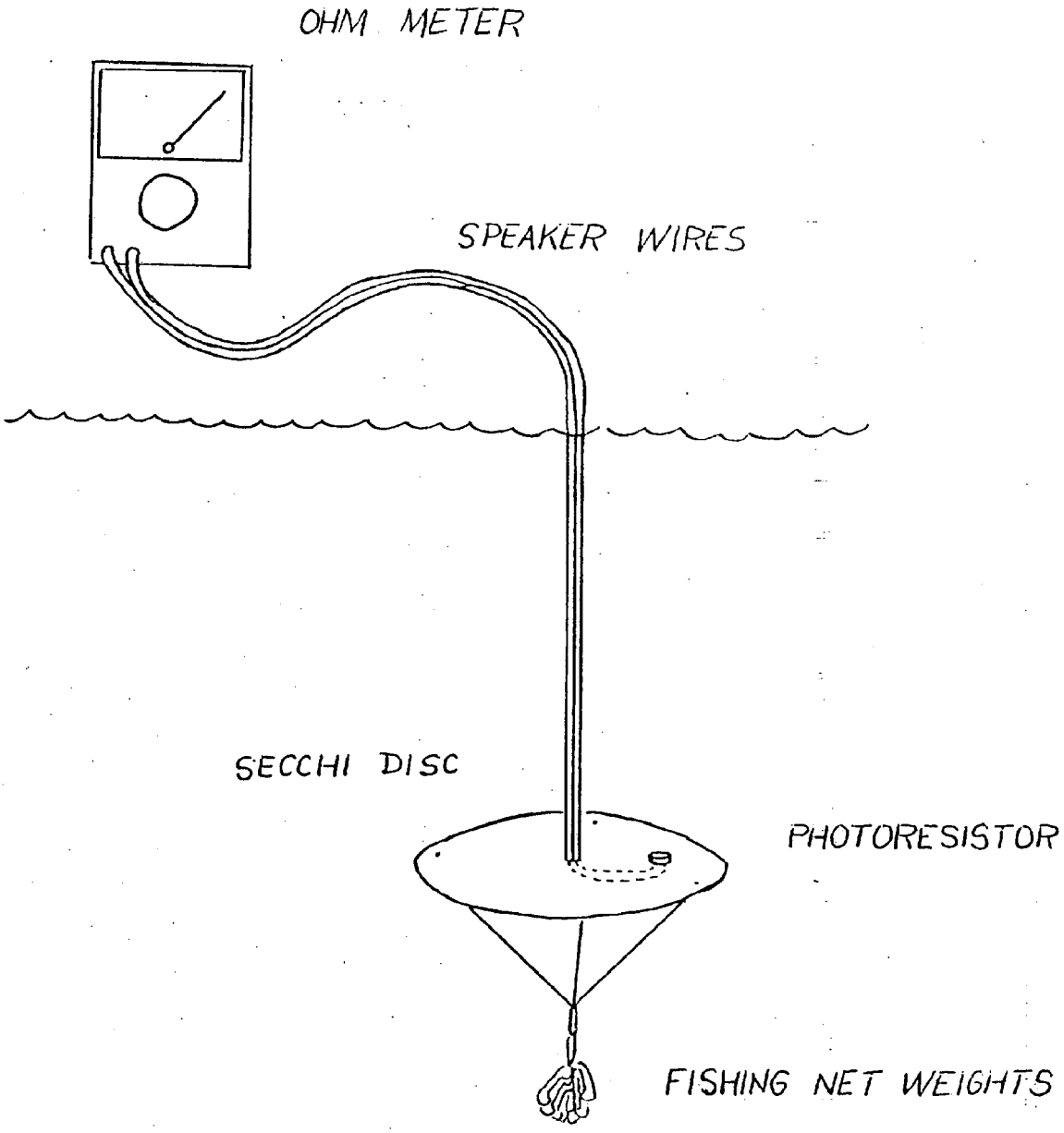
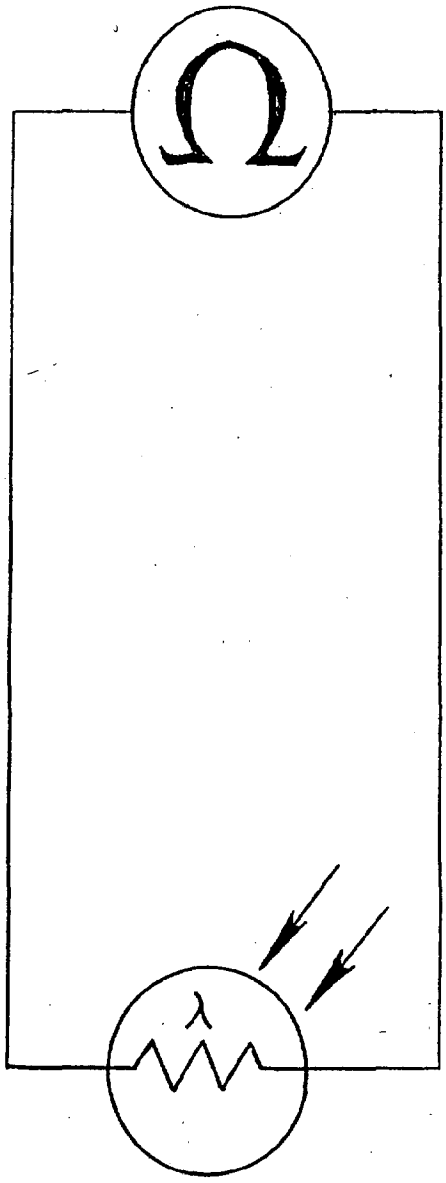


FIGURE 1

SCHEMATIC DIAGRAM

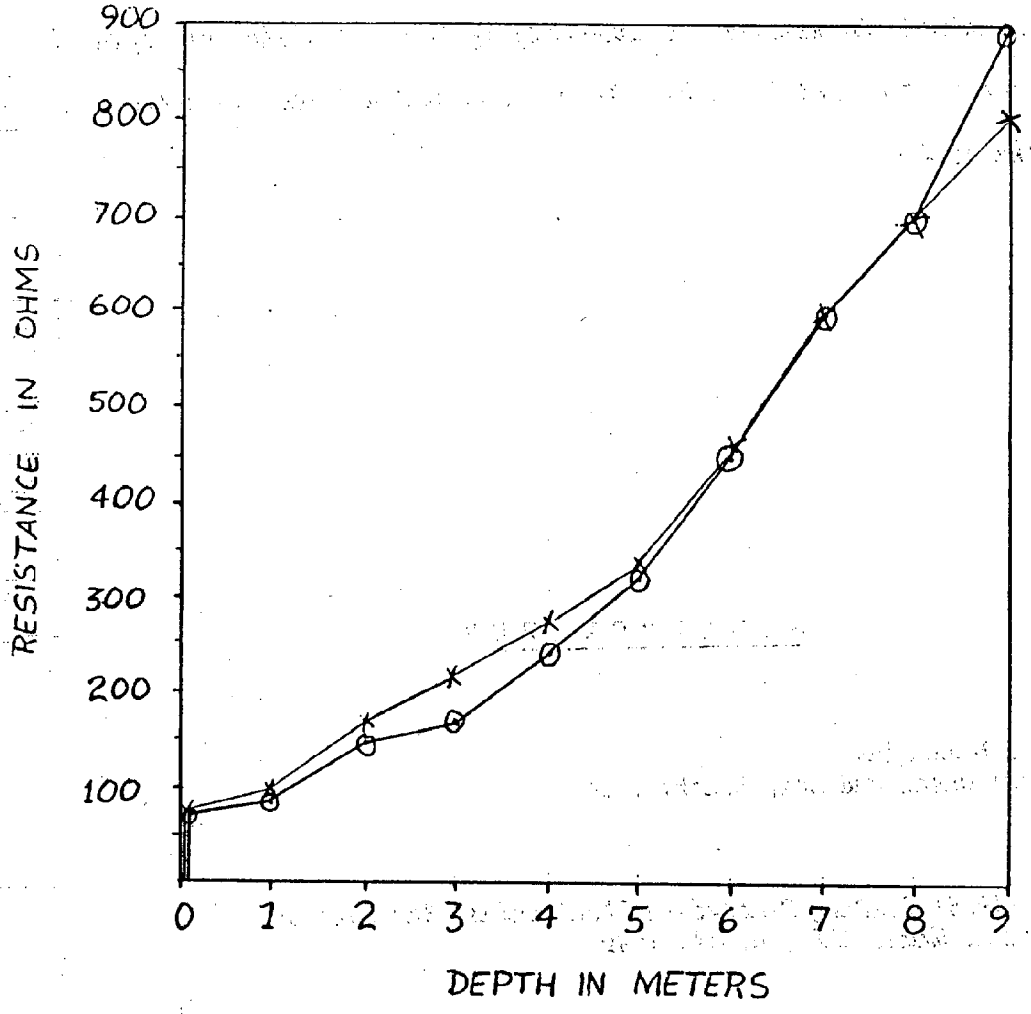


KEY

OHM METER Ω

PHOTORESISTOR λ

FIGURE 2



KEY

FIRST READING

SECOND READING

FIGURE 3

CONCLUSION

A device was made to measure the intensity of light at different depths in seawater, it was tested, and it works. Temperature did not seem to affect the readings of the device.

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A Method for Recording Sounds from Crustaceans.

Fa'amaile Tapafua - Tafuna Techincal High School.

ABSTRACT

An underwater microphone was attached to a tape recorder. A Crustacean was caught and placed in the aquarium. The water was created with an air pump. I was unable to record sounds from this crustacean. The speciman was changed and I got a stomatopod from Fatu and Futi. I was able to record sounds from this crustacean. The sounds are caused by the shrimp striking an object.

PROBLEM STATEMENT

The goal of this project was to find a procedure for recording crustacean sounds into an underwater microphone and onto a cassette tape.

LITERATURE REVIEW

Crustaceans are in the Animal Kingdom udner the phylum Arthropoda. Members of the crustacea include crabs, shrimps, lobsters crayfish and pill bugs. Most crustaceans are marine, but there are some freshwater and terrestrial species. The crustaceans can be divided into eight classes (Barnes, 1980 p. 672). Class Malacostracca is of interest to this paper, because it has two orders (Decapoda and Stomatopoda) whose members were tested for sound.

Some crustaceans are very noisy and make their presence konwn at the slightest disturbance (Schmitt, 1965). One reason scientists are interested in this type of research is that some crustacean sounds affect underwater detection equipment. The author of this paper chose this title because of her interest in crustacean sounds.

MATERIALS AND METHODS

An aquarium was built out of window louvers. An undergravel filter, which

was made of plastic window screen and plastic grating, was placed in the aquarium. An underwater microphone obtained from Edmond Scientific Supply Co. was glued to the side of the tank with silicon glue. Sand was placed on top of the undergravel filter and some fresh sea water was added. The water was created with an air pump. (Fig. 1).

The tape recorder used was a Realistic Cassette Stereo Recorder, model number SCP-17. The type of tape used was SANYO TYPE 1 RX 60 LOW-NOISE CASSETTE TAPE. The following procedure was used to try to record sound. The air hose to the filter was taken out. A tape recorder was attached to an underwater microphone. The tape was on and some different obnects were poked in front of the shrimp. the shrimp hit the objects, sounds were recorded from the underwater microphone onto the cassette tape.

RESULTS

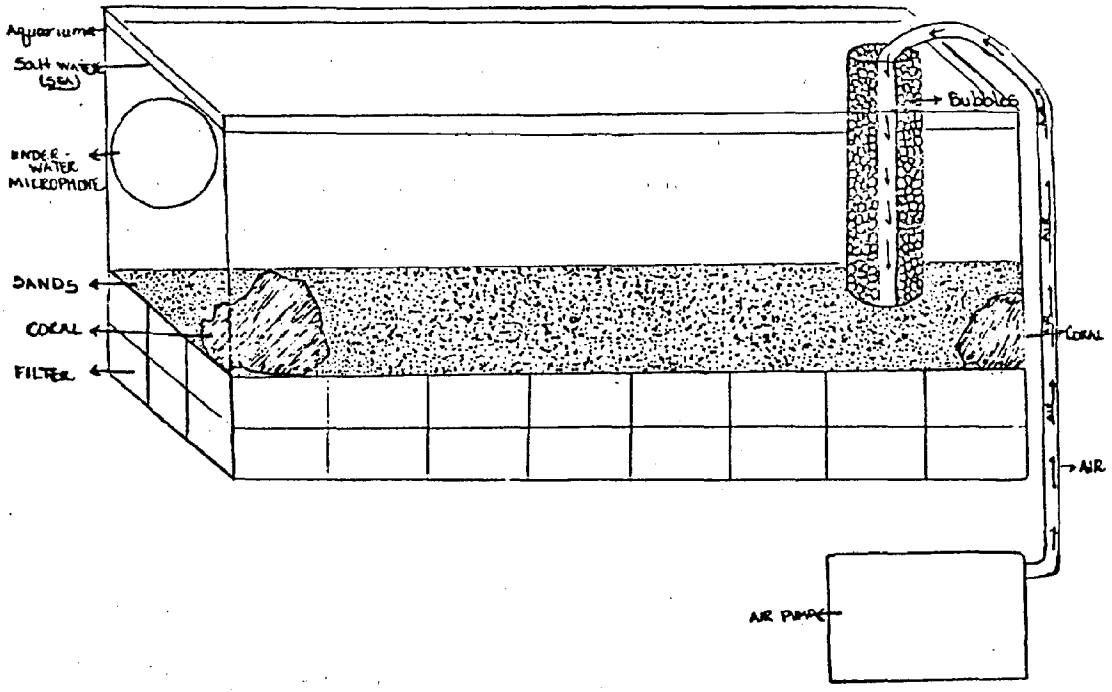
No sound was recorded from the decapod crustacean (crab) (fig. 2) Three attempts were made.

Sounds were recorded from the stomatopod crustacean (see fig. 3). It seems the sounds depend on the object the stomatopod strikes with its dactyl. Some objects used to test this sypothesis were a plastic rod, a nail, a rolled piece of paper, a wire, a stick and a pencil. The objects were hled in front of the stomatopod and it struck them.

DISCUSSION

Attempts to record sounds from the decapad crustacean were not successful. It is possible that the crabs made sounds with frequencies to high or too low for the microphone to detect. It is more probable that these decapods do not make sounds.

FIGURE 1



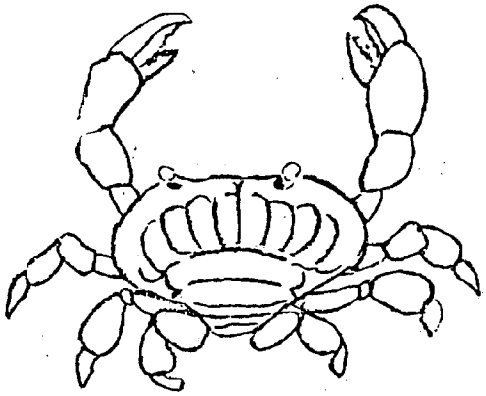


FIGURE 2

FIGURE 3

Sounds were made by the stomatopod crustacean. At first it was not clear whether the sounds came from some part of the stomatopods body or whether they were caused by the stomatopod hitting something. The test these two possibilities different object, were placed in front of the stomatopod. The sound that came from the stomatopod was different when different objects were struck. This shows that the sounds doesn't come from the legs. It comes from the striking of the object.

CONCLUSION

My project was successful. Sounds were recorded from a stomatopod on to a tape lasts a very short time and depends on what the shrimp stricks.

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Eunice viridis: Is there a Difference Between Male and Female Palolo?

Annie Uiagalelei - Fa'asao High School.

I. ABSTRACT

In the Samoan islands, there is a sea annelid known as Palolo or the scientific name for it is Eunice viridis. The timing with which the palolo appears to breed is remarkable. There is the male palolo and the female palolo. I shall try to investigate the breeding habits, appearance and the differecne between the male palolo and the female palolo through observation and measurement. The weight of the palolo fragments was the primary factor used to distinguish between male and female.

By weighing the fragments of the worms, I found out that there were more female fragments than male fragments of the worms.

INTRODUCTION

It is midnight on the eighth day after the full moon of November and the sky is dark. Here and there a lantern moves across the waters of the reef as a figure bends low and peers into the water. On the beach, clusters of people dance and sing while waiting for the reef watchers to give them a sign that the palalo has come, but the reef watchers are silent. In the village, the children gather the materials to be used by the members of their family who are going to fetch the palolo. Some of the women sit in front of their houses stringing flowers into a necklace or an ula to wait for the coming of the palolo. Suddenly, one of the reef watchers moves about and quickly scoops his hand into the water and cries the palolo has come. Immediately, the people of the Samoan Islands grab their materials brought by their children, laughing and pushing each other to get a good position. The light from their lanterns helps them see where the worms are across the dark. For the next hour or two, the people of the Samoan Islands work feverishly to scoop as many of the squirming creatures into their baskets or buckets before the palolo "melts" or Motusaga. For the palolo comes to the surface of the waters only twice a year.

The annual rise of the palolo is a great mystery. The palolo rise occurs in October, sometimes in November and occasionally the palolo rise occurs in both October and November. After a certain amount of time, the gametes are released and fertilization takes place causing the worms to explode allowing the male and female to mingle and reproduce.

THE SAMOAN AND THE PALOLO

The palolo then is not peculiar to the Samoan islands but many observers and writers have noted the high regard in which it is held by Samoans. One writer even described the Samoans as being "crazy for the palolo." It is only natural that a creature that appears in such a dramatic way and that is eaten with such relish would attract legends to explain its origin and habits.

Ventral eyespots, tufted gills, sexual maturity - these do not concern the Samoan (the islanders interest in the palolo has little to do with its zoological characteristics.) Through hundreds of years of catching and eating the palolo, the Samoan has had to deal with other kinds of questions; where did the palolo come from? on just which day will the palolo come? how can you tell if you do to make the palolo rise in large numbers? What can you use to scoop thousands of tiny wriggling worms out of a choppy surf? How do you eat or cook a bundle of wriggling worms? In a tropical climate can you preserve some palolo for later use?

MYTHS OF HOW THE PALOLO WAS FOUND

In the mythology of Samoa, the Manua group of islands holds a special place. The following story about the palolo was told by the late Talking Chief Siva of Tau village, Tau island, Manua. "Everything that is good starts first in Manua. The sun rises first in Manua. Tha palolo rises first in Manua.

A long time ago there was a man named Lalafatau. He lived in Manua Islands. His own home was a big rock. He was always fishing, every day. One day he got an eel from the river...He thought, "What shall I do with that eel?' He thought, 'I must cut that eel in two parts,' and he cut that eel. The first part is the head and the second part is that tail. Lalafatau brought the eel out into the sea and the eel sank down into the bottom of the sea. In the sea the tail sank beside the big stone. The name of the stone is puga. The puga at the tail of the ell. There is no tail, only the puga.

Lalafatau threw the tail in the sea in the month of September. In the weeks from September to October he went to the sea with his boat and looked way down. He saw that the big stone had borne out the things like worms. Lalafatau put his hands into the sea and he picked those things up. They melted on the first night. The second night the puga borne again. He picked them up again. The things were hard. So he returned to his home and named those things palolo."

MATERIALS AND METHODS

The worms on which my experiment were done were collected on November the 6th early in the morning around 2:00 to 4:00am. The worms were collected in a net that was round. The Palolo was frozen, but before I did my experiment I defrosted the worms for half a day.

The first part of my experiment was counting how many female and how many male, but that wasn't possible because they were fragments of the worm. The second part of my experiment was measuring the length of the worm, but that wasn't possible because there were fragments of the worm.

The experiment could not be done correctly, so one way the answer could be found is paying specific attention to the weight of each fragment. I placed each fragment one by one under the microscope to see which was green and which was brown. I used a balance beam scale to measure the weight of the fragment. I put all the brown ones first on the beam scale and then I put all the green ones under the beam scale.

WHERE DO THE PALOLO LIVE?

The palolo lives in a dead reef rocks near the reef passages. The rock is a porites coral rock. Why the palolo lives in the dead rocks is not known. The palolo is not an entire animal but only part of a sea annelid. The worms themselves are much thicker that the palolo, their segments shorter, but very much broader.

WHY DID THEY NAME PALOLO EUNICE VIRIDIS?

The earliest published description of palolo is given by Rev. J.B. Stair. He sent a specimen to the British Museum, where is was placed near the Arenicolodal and given the name palolo viridis. The palolo was reclassified as Lysidence Viridis until 1898 when Friedlaender found a head which he determined to be a Eunice. So they named the palolo Eunice viridis.

The worms are very brittle and when broken, each piece swims off as though is was an entire annelid. If the worms are immature when picked by human hands, they will break and/or melt, disappearing totally.

The total length of Eunice viridis is about 100mm (16 inches) and the length of the free-swimming part is an average of about 300mm. The posterior portion of the body resembles a segmented cylinder with segement bearing a pair of brittles and a ventral eye. The male is reddish brown or yellow. The female, deep bluish green, the deep green color of the ova in the female's posterior region gives the specific name viridis.

RESULTS

The male fragment of the worms were not more that one gram and the female fragments of the worms were approximately two grams. I also found out that you can classify which is male and which is female by color. The male palolo is browninsh red. The female palolo is bluish green.

DISCUSSION

If I did my experiment the following day that the palolo was brought into our house probably the complete experiment or the complete graph will be completed. However, I froze it and freezing the palolo made it really complicated for me to finish the graph or the experiment because you can't find out which of the male or female is longer because the worms melted and broke down into fragments. I could only do one thing which was the weighing down of the fragment of the worm. If you weigh something down it always tells you how big, how small, or how long, how short or which is more and which is less.

CONCLUSION

My conclusion is that my hypothesis is true. There is a difference between male palolo and female palolo. I found out that whatever the size, shape and how strong or weak the fragments are, the weight will always be the same.

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The Spawning and Early Development of Palolo.

Vaolele Lauofo - Leone High School.

ABSTRACT

Collection of palolo was made on November 13, 1987 from the village of Fatu ma Futi in Tutuila, American Samoa. Palolo eggs and sperm were collected together and later seperated for the observation of the fertilization and larval development. The fertilized egg underwent its first cell division approximately after the fertilization. After four hours, observations were made and the cell divisions became numerous and uncountable with the equipment available to me at that time. Within six hours, the egg underwent a type of cell specialization. Approximately sixteen hours after the fertilization, the early trochophore was observed and finally after thirty-seven hours, the later trochophore stage was reached.

INTRODUCTION

Palolo is the Samoan word for a unique sea annelid. The scientific name for palolo is Eunice viridis. For many centuries, the Samoan natives have caught palolo, being that it was considered a great delicacy. The Samoan Islands are not the only place where palolo appears. Other islands that have been reported to have palolo appearances include Fiji, Tonga, the Cook Islands (Rarotonga), Solomon Islands, and part of New Hebrides [Burrows, 1945]. However, most research and data on the E. viridis has been done in the Samoan Islands. In Samoa, the ability of predicting the palolo

spawning was first discovered by early Samoans who recognized the relationship between the phases of the moon and the spawning of the palolo. The palolo spawning in Samoa occurs during the three evenings of the third quarter moon in either October or November. If the palolo does not spawn in October, it will in November. For example on October 15, 1987, the phase of the moon was appropriate but palolo did not spawn in the waters surrounding Tutuila. But on November 13, 1987, the next predicted night, palolo did spawn and in abundance. Palolo occupies tunnels in massive blocks of coral limestone [Casper, 1984]. On the night of the spawning, the palolo comes out of its tunnel and releases its epitoke [Casper 1984]. The epitoke is the region of the worm that contains the gametes, cells capable of participating in fertilization [Barnes,1980]. The epitoke ,then, squirms through the water to reach the water's surface. The waves and currents carry the epitoke towards the shore. The gametes are released and the fertilization of the eggs begin. After the eggs are fertilized they undergo cell division, develop into larvae and sink to a suitable substrate [Woodworth, no date]. However, there are other possibilities of where palolo may go. Palolo may live on the surface of the reef or maybe as plankton then sink to the ocean bottom then burrow into coral. But, there is no certain answer. Palolo has four stages of development: the embryotic, larval, juvenile, and adult. It is known that adult palolo gnaw tunnels in coral limestone and remain

there until the next spawning season [reference]. The anterior part of the palolo known as the anotokal, which stayed in the coral during spawning period, regenerates its posterior region and gametes, and remains in the coral until the following spawning period when it releases the new epitoke [Woodworth, no date].

Literature on the reproduction of palolo is limited, but none have data pertaining to the larval development of palolo. Therefore, my first objective was to observe and document the early stages of the development of palolo.and development of palolo is unavailable.

METHODS AND MATERIALS

First, I had to determine the night that the palolo was supposed to appear. I did this with "Moon Age Z", an Apple IIe computer program which shows the stages of the moon and the exact date and time it would be at that stage. Based on the program, October 29th and November 13th , both at 2:01 A.M., had the appropriate phase of the moon for the appearance of palolo. However, palolo did not spawn in October. Thus I waited for the November spawning period. On November 13, I got a fine woven net to catch palolo, a bucket to hold them and a flashlight. At 12 PM I left for the village of Fatu ma Futi because this village in the past years has had a consistant spawning of palolo. At 1 PM, I went into the water with my palolo net. With my flashlight I looked into the water and saw a group of palolo. I scooped them up with my net into the bucket. I continued catching palolo in this manner and then I rushed home and placed the palolo into three separate one-gallon aquarium jars with adequate aeration. I used three jars so that in case one jar was contaminated I would have extra palolo to continue my experiment. I also had two aquariums set up at school which I placed palolo in. I got three 250ml beakers (numbered 1,2,3), an eye dropper, a microscope with some glass slides, and a timer. I hooked up the air pumps to the jars and placed the palolo in them. I picked out a female palolo and squeezed out its gamete and placed it in beaker #1. I did the same with a male palolo and placed its gamete in beaker

#2. By using the microscope, I determined the sex of two palolo by their gametes. The blueish-green palolo had eggs (female) and the reddish-pink palolo (male). I combined the solution of the female gametes and the solution of male gametes into beaker #3. I used an eye dropper to get a drop of the solution of the mixed gametes in beaker #3 and observed it under the microscope and recorded all observations. I did this every hour for the first six hours and then every few hours for the remainder of my experiment.

RESULTS

When I squeezed out the gametes from the epitoke it became transparent. Thus the color of the epitoke is dependent on the pigmented gametes rather than the color of the skin itself. Under the microscope, I first observed the eggs and they were greenish-blue in color, the sperm were white. When I mixed the gametes and observed them, the sperm were attracted to the eggs (see fig. 1). They continuously swam around the eggs and eventually fertilized the egg as evidence of the fertilization envelope (see fig. 2). Within an hour after fertilization the first cell division could be observed. Due to the late hour of the spawning and setting up of my experiment I fell asleep and when I awoke the cells had divided to the stage that I could not actually count the cells (see Fig 3). The time that had elapsed was four hours. Within six hours the cells had undergone a dramatic change and began to undergo a type of cell specialization (see fig. 4). Within 16 hours after fertilization the early trochophore appeared (see fig. 5). I distinguished the cilia

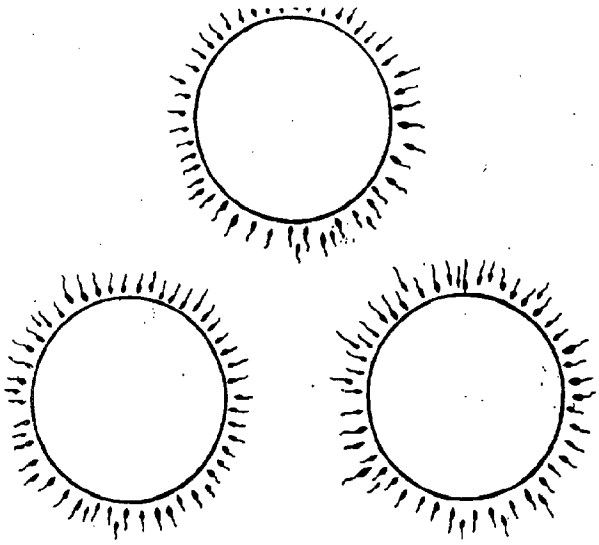

Figure 1 - Palolo sperm being attracted to the eggs.

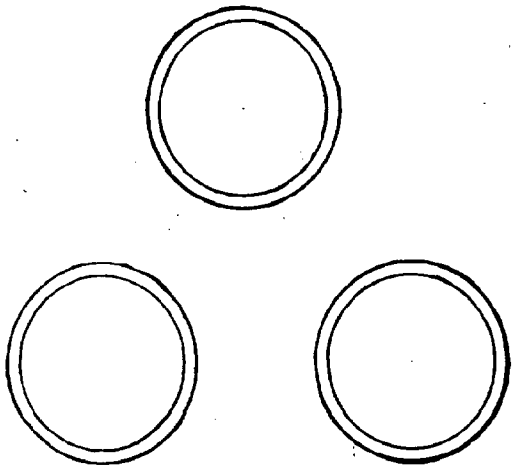

Figure 2 - Fertilized eggs as evidence by the fertilization envelope.

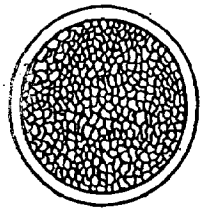

Figure 3 - (Four hours) The egg with uncountable cell divisions.

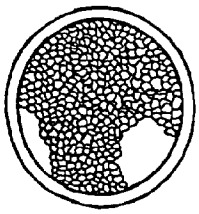

Figure 4 - (Six hours) The egg undergoes cell specialization.

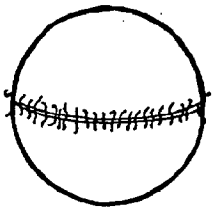

Figure 5 - (Sixteen hours) The early trochophore stage.

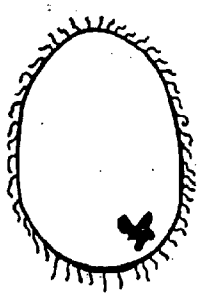

Figure 6 - (Thirty-seven hours)The final trochophore stage.

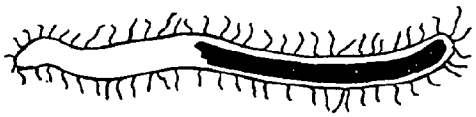

Figure 7 - (One hundred days)The juvenile stage of Palolo.

and the egg had started to rotate in a counterclockwise manner. After 37 hours the trochophore stage had been reached (see Fig. 6).

CONCLUSION

The E. viridis is a fast developing sea annelid compared to other sea annelids. For example, the Glycera convoluta takes ten days to become a trochophore, whereas the palolo only takes thirty-seven hours. The main questions that rises are "why is the development so fast?" and "where do palolo go during their stages of development?".

Many fish broadcast their eggs on rocks, rubble, or gravel substraits. Their larvae hides for a typically short time in the spawning subtraits and are adapted to the well oxygenated waters.

Other fish release buoyant or semi-buoyant eggs into the open waters, where the currents are available for immediate disbursal of the eggs and recently hatched larvae. These eggs and larvae are often referred to as "ichthyoplankton". Through data found, I feel that the E. viridis also goes through this type of gamete distributions.

The E. viridis seems to reside in specific near-shore areas which are associated with the coral "Porites" and with a certain type of vegetation.

Some habitat attributes important to palolo includes substrait in water velocity, level, temperature, and oxygen content.

The palolo disbursal are directly affected by flow, the volume of water passing by at a specific point per unit

time. And this occurs during the three nights of the palolo spawning periods.

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Local Marine Symposium Stimulates Kids

(DOE Press Release) - Last week was a milestone week for science here in the Territory. In addition to a very successful science fair the Territory held its first marine symposium. The first Amerika Samoa Marine Symposium, co-sponsored by the Department of Education and American Samoa Coastal Management Program was held Thursday evening at the Fono Fale.

The purpose of the Marine Symposium is to encourage students to carry out research on the marine environment and to provide them with an opportunity to present their reports to an audience of scientists, peers, and the public. All high school students were invited to take part in the program.

For the last six years, DOE and CZM have been sending representatives to the Hawaiian Marine Symposium but because of the overwhelming response we held our own symposium this year. There were 18 papers presented on topics ranging from "The Songs of the Humpback Whales," to "Water Pollution," and "A Device that Measures Light Intensity in Seawater."

Eleven of the 18 participants were from Manua High School and Leone, Faasao, and Tafuna Technical High School were also represented.

Three papers were selected by the panel of judges to represent American Samoa at the Hawaiian Marine Symposium in late April. Tana Crookshank of Faasao will present her paper entitled "A Two-Year Study of Coliform Pollution in Pago Harbor;" Vaolele Lauofo of Leone will paper called "The Spawning and Early Development of Palolo" and Siaosi Savelio from the Technical High School will be presenting a paper on "A Device that Measures Light Intensity in Seawater."

Congratulations to these three students and to all of the students, advisors, and judges who made the symposium a success! We look forward to an even better Second Annual Symposium next year. •

STUDENT PRESENTERS

Tana Crookshank — Faasao High School

Coliform Pollution In Pago Harbor (A Two Year Study)

Ianeta Tupuola — Manu'a High School

Prevention of Pollution on a Coral Reef.

Aiga Tigilau — Manu'a High School

How the Ocean Began.

Fuatia Mata'utia — Manu'a High School

How Ocean Currents Affect the Climate.

Sa'ovale Clara Mapu — Fa'asao High School

Water Pollution.

Fuala'au Tufi — Manu'a High School

The Whaling Industry in Hawaii.

To'aiva Salesa — Manu' High School

Factors Affecting Waves.

Wynona Panama — Leone High School

Songs of the Humpback Whale.

Siaosi Savelio — Tafuna Technical High School

A Device that Measures Light Intensity in Seawater.

Fa'amalie Tapafua — Tafuna Technical High School

A Method for Recording Sounds from Crusteceans.

STUDENT PRESENTERS

Ramona I. Live — Manu'a High School

Collection and Uses of Sea Urchins in Am. Samoa.

Natalie Ah Soon — Manu'a High School

Habits of the Jellyfish.

Momeneta T. Ume — Manu'a High School

How Lobsters Protect Themselves from their Enemies.

Elesi M. Pese — Manu'a High School

How Moray Eels are Different from Other Fish.

Elizabeth Ali'itaeao — Manu'a High School

Types of Parrot Fish and their Environment.

Sianiva Fa'apouli — Manu'a High School

How the Octopus Moves.

Annie Uiagalelei — Faasao High School

Eunice viridis: Is there a Difference Between Male and Female Palolo?

Vaolele Lauofo — Leone High School

The Spawning and Early Development of Palolo.

*Papers from Manu'a High School were not available for this printing.

New Formula Devised for Educating Science Students

By ALLEN SYKORA
Sentinel Staff Writer

For years, Sitka High School teacher Bill Foster had wished there were an alternative to the old-time "science fairs," and finally he has learned the answer.

For two straight years, a student "science symposium" has been held in Sitka. And this year, three participants from the local symposium, including Sitka High senior Brock Bauder, were selected to take part in a larger symposium that took place in Hawaii.

"I've been to a lot of science fairs," said Foster, noting that the work sometimes turns into "craft projects" more than research projects.

"This is a more realistic alternative to science fairs."

The Second Annual Student Symposium on Alaska's Aquatic Resources was held in Sitka in conjuction with the chamber of commerce's marine trade show this spring.

Organizers issued a call in the fall to students in a number of a schools to submit research papers, "just like scientists do," said Foster. Students then did research, put together papers, and gave presentations at the symposium. After their reports, they were grilled with sometimes tough questions.

"We felt there's a need for high school science students to participate in the way that real scientists do papers," said Foster. "It probably best duplicates a real scientific meeting."

The local student symposium was sponsored by the 4-H program of the Cooperative Extension Service. Other organizers with Foster included Extension Agent Jill Thayer and Sitka High teacher Ray Verg-in.

The Sitka-based symposium had two categories, one with presentations by high school students in Southeast, and another with presentations by Sheldon Jackson College and University of Alaska-Southeast students.

From the high school division, three students and their presentations were selected to take part in the 13th Annual Student Symposium on Marine Affairs in Hawaii on April 30.

Bauder gave a report on the giant wave that hit Lituya Bay, 135 miles northwest of Sitka, following an earthquake on July 9, 1958. A massive landslide caused a wave to climb 1,740 feet up a mountainside, sheering trees in its path. Another enormous wall of water some 100 feet high swept through the bay.

In addition to book research, Bauder said he interviewed Sitkan Howard Ulrich Sr., who was anchored in the bay at the time in the fishing vessel Edrie and was carried on a wild roller coaster ride.

Bauder's report was "a real hit" at the Hawaii symposium, said Foster, who attended the symposium as a chaperone.

The other Alaska students who attended were Mt. Edgecumbe High School junior Chanda Aloysius, who gave a presentation on the school's student-run fish business used to teach entrepreneurship, and Pelican freshman Greg Lundahl, who made a presentation on rockfish identification using a computer program.

"It's probably the first time Alaskan, Hawaiian and Samoan students have met in a symposium," said Foster, noting that students from the American territory of Samoa had to travel as far north as the Alaska students had to travel south.

Funding to assist Alaskans involved in the syposium came from the Alaska Department of Education, Alaska Sea Grant, Mt. Edgecumbe High School, Sitka Native Education Program and personal contributions.

"It was really an educational experience," Foster said. "We'd like to continue it, I guess."

Said Bauder, "It was really valuable. I learned not only how to write a scientific paper, but how to get in front of about 150 adults and high schoolers and give them a presentation, have them not know what I was talking about (ahead of time) and try to make them knowledgeable.

"The majority of people learned a lot and would go again if given another chance. I know I would. Not because it's in Hawaii, but because it's a worthwhile trip."

NORTH MEETS SOUTH — Alaska and American Samoa students met during a science symposium held recently in Hawaii. Pictured, from left, are Brock Bauder, Sitka; Greg Lundahl, Pelican; Siaosi Savelio and Vaolele Lauofo, from Samoa high schools; Chanda Aloysius, Mt. Edgecumbe student from Holy Cross; and Tana Marie Crookshank, from another Samoa high school. (Submitted photo)